**EPITHELIAL TISSUE**

Dr. Crissman

H.I.R Chapter 4

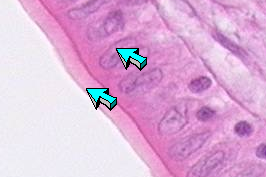
This laboratory exercise may be divided into three portions consistent with the major functions of epithelial tissue. The first portion is a study of the cell surface modifications which allow epithelial cells to do their jobs. Next, we study the different types of epithelia which line all surfaces. Finally, there is a brief portion concerning gland classification and structure.

**CELL SURFACE MODIFICATIONS**

**MICROVILLI**

[**[MCO 0077**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0077&type=ax&section=epithelium)**]** Peyer's patches [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0077&type=jv&section=epithelium) HIR-*frame 172*

[**[LH 0130]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0130&type=ax&section=epithelium) Jejunum [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0130&type=jv&section=epithelium)



(Microvilli 🡪 make up brush border and Simple Columnar cells with elongated nuclei)



(Bassil Laminar and Connective Tissue)



(Goblet cell and brush border)

This section (**MCO 0077**) is from the ileum of a primate. Observe the cells of the epithelium (on the long finger-like processes) of the small intestine. These cells are columnar and have elongated nuclei. With high magnification, notice the relatively dark staining brush border on the free surface of most of the epithelial cells. In the jejunum section (**LH 0130**) the brush border of microvilli can be observed on the surface of the long tall villi of this portion of the small intestine.

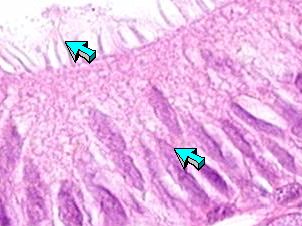
In the EM demonstration micrographs, it can be seen to consist of numerous individual microvilli. *It is not possible to resolve individual microvilli with the light microscope*. You may wish to think about the resolving power of the light microscope and consult your texts about the dimensions of microvilli. Know the important function of microvilli. Microvilli do not have basal bodies. They contain numerous actin microfilaments which connect to the terminal web. Know how that is attached within the cell.

\*\*\*Microvilli are homogeneously arranged

**STEREOCILIA**

[**[MCO 0116]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0116&type=ax&section=epithelium) Epididymis, Human [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0116&type=jv&section=epithelium) HIR-*frame 193*

[**[SL 026]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL026&type=ax&section=epithelium) Epididymis [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL026&type=jv&section=epithelium)

(Pseudo stratified columnar epithelium and Stereocilia)

At low magnification, look for the long coiled ductus epididymis which has been sectioned at various angles and appears as varying shaped tubules. This tubular structure is lined with an epithelium. Find a region and examine the epithelium next to the lumen under progressively higher magnifications. Note that the epithelial surface is covered with a shaggy coat of long stereocilia which tend to clump into small groups. These are not motile cilia. Rather, they are exceptionally long microvilli and represent an adaptation for the absorption of fluid by increasing cell surface area. Therefore, their name is misleading. Know how to distinguish between stereocilia and cilia at the light microscopic and electron microscopic levels. Know the characteristics of each.

**CILIA**

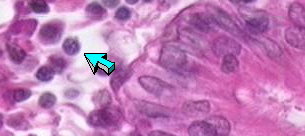
[**[MCO 0060]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0060&type=ax&section=epithelium) Trachea & Esophagus, Rodent [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0060&type=jv&section=epithelium) HIR-*frame 191-192*

[**[MCW 021]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW021&type=ax&section=epithelium) Trachea, H&E [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW021&type=jv&section=epithelium)

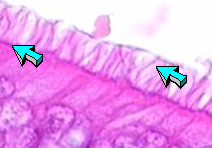
[**[SL 035]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL035&type=ax&section=epithelium) Trachea [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL035&type=jv&section=epithelium)

(Pseudostratified Ciliated Columnar epithelium and Cilia)



(Areolar Connective tissue)



(Basal bodies or Junctional Complex and Cilia)



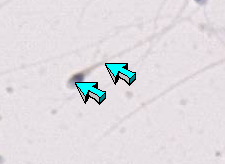
(Simple Cuboidal epithelium [Gland cells])

  \*Can distinguish that they are cilia because

On the lowest power objective (4x), identify the trachea (larger, rounded lumen on **MCO 0060**) and observe the cells lining its lumen (respiratory epithelium) using progressively higher magnifications. Only trachea is present in **MCW 021** & **SL 035** slides. There are two partial sections (longitudinal and cross sections) of the trachea on **SL 035** slide. The epithelial side (inside of trachea) is present on the top side of each section. The trachea contains one of the best examples of ciliated cells, which are easily observed under high magnification. Understand the function of these cilia. Cilia are attached and supported by basal bodies. Know how you can distinguish between cilia and microvilli at the light and electron microscopic levels.

**FLAGELLA**

[**[MCO 0003]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0003&type=ax&section=epithelium) Sperm Smear [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0003&type=jv&section=epithelium)



(Sperm head and Flagella)

This is of a sperm smear at the light microscopic level. Spermatozoa are found by locating the very darkly stained head. The sperm tail is the only good example of flagella in the body, which can be easily seen. But remember, flagella have been identified (by electron microscopy) in other tissues. Look carefully at the EM demonstration micrographs to see better detail of flagella, and also the mitochondria within the mid-piece.

**EPITHELIAL TYPES**

It is important that you learn to recognize and identify the different types of epithelia. The ability to distinguish these will greatly facilitate your later study of the microanatomy of individual systems. *In this lab the emphasis is on the types of epithelia present in the organ, not being able to identify the organ.*

All of the free surfaces of the body, both external (skin) and internal (tubes and cavities), are lined by specialized cells which serve as a sheet-like barrier to protect the underlying tissues. These specialized cells are called epithelial cells and are held together by specialized intercellular junctions. Epithelial cells also constitute the secretory parenchyma of many glands. This is because glands develop from a surface layer of epithelial cells which invaginate into a connective tissue stroma.

Epithelial tissue is *avascular* and therefore is dependent upon the underlying connective tissue for its vascular needs. The epithelial cells "rest" on the basement membrane in the extracellular matrix. It is derived both from the epithelium as well as from the connective tissue. This tri-layered structure (basement membrane) consists of the lamina lucida (an amorphous component) and the lamina densa (an electron dense area), both of which are of epithelial origin. These two regions together are known as the basal lamina. Finally, there is the lamina reticularis (a fibrillar component), which is connective tissue in origin. *While the basement membrane can be seen at the LM level, the above-mentioned three layers can only be distinguished using electron microscopy.* Also, remember that the basement membrane is not really a membrane (like the plasmalemma or any other cell or subcellular membrane), but 3 layers of extracellular matrix materials in the connective tissue.

It should be noted here that often times, and incorrectly, the terms basement membrane, basal lamina, and boundary membrane are used synonymously. Some tissue contains only the lamina densa portion of the basement membrane, but it is not uncommon to find any of the preceding terms used. We will use the terms as first described above and in your textbook.

The basement membrane is important clinically as it is a factor used in the prognostic staging of carcinomas (uncontrolled, malignant growths of epithelial cells).

Epithelia tissues are usually classified according to the *shape of their cells*:

**squamous** - flat

**cuboidal** - cube-like

**columnar** - tall and narrow

as well as by the *number of layers of these cells:*

**simple** - one cell layer

**pseudo stratified** - appearing multi-layered but in reality only a single layer

**stratified** - multiple cell layers

**transitional** - highly specialized for stretch

In stratified epithelia, ***the classification of cell shape is based on the shape of the cells at the surface layer*,** and not the other layers which may be of considerably different shapes than those at the surface.

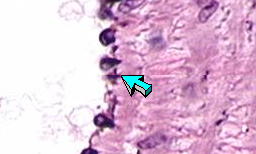
A. **SIMPLE EPITHELIA**

1) **Simple Squamous Epithelium** - contains flattened polygonal cells with a centrally located nucleus which usually causes the cytoplasm to bulge. These cells line the heart and the blood/lymph vessels and in these locations are called endothelium. They also line the body cavities and the periphery of many visceral organs where they are called mesothelium. Simple squamous epithelium is also found in body organs, e.g., lining the pulmonary alveoli or the renal glomerular capsule (Bowman's capsule).

[**[MCO 0058]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0058&type=ax&section=epithelium)Artery, Vein & Nerve, Elastic Tissue, Cross Section [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0058&type=jv&section=epithelium)

HIR-*frame 593*

[**[MCO 0658]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0658&type=ax&section=epithelium) Artery, Vein & Nerve, Elastic Tissue [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0658&type=jv&section=epithelium)

 (Artery)  (Vein)

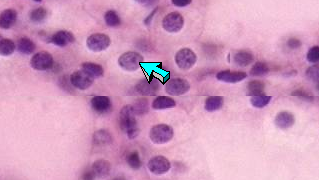
(Endothelial Cells 🡪 Simple Squamous)

This contains a portion of both arteries and veins. The arteries are thick walled, while the veins are thinner and look collapsed. In this slide, start with the large artery. Locating and defining the epithelia is simplified in this slide, since the internal elastic lamina (elastic sheet), which separates the epithelium from the rest of the arterial wall, is stained black. Look at the cells on the luminal side of this elastic sheet. In the artery, since the surface is somewhat distorted, the cells will not look as flat as in the previous slide. Search the vein for good views, and also look at some of the other smaller vessels in this section.

1) **Simple Cuboidal Epithelium** - line and/or form the ducts of many glands. The follicles of the thyroid gland show good examples.

[**[UW 093]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf7_UW093&type=ax&section=epithelium) Thyroid, Cat [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf7_UW093&type=jv&section=epithelium) HIR-*frames 164, 167*

[**[LH 0195]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0195&type=ax&section=epithelium) Thyroid [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0195&type=jv&section=epithelium)

(Simple Cuboidal Epitelium)

This is a section through the thyroid gland showing many follicles (liquid-filled spheres) of various sizes whose peripheral layer of cells are approximately cuboidal in shape. The pink substance inside the follicle is hormonal material.

2) **Simple Columnar Epithelium** lines much of the human gastrointestinal tract, including the stomach, intestines, gall bladder and the major ducts of the digestive glands (biliary, pancreatic, and salivary). These columnar cells are characterized by tall cells with oval nuclei, which are usually located in the basal region of the cell.

[**[MCW 071]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW071&type=ax&section=epithelium) Jejunum, Cresyl Violet [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW071&type=jv&section=epithelium) HIR *frames 172-173*

(Goblet Cells and Simple Columnar epithelium) (Brush Border/ microvilli)

This illustrates simple columnar epithelium which can be found along the luminal border of the tall villi protruding from the surface of the organ. Observe that these epithelial cells possess a "striated" or "brush" border which can easily be seen with high power. Also interspersed within the epithelium are goblet cells which appear as "clear spaces" in this type of preparation. In this slide, the goblet cells are ovale-shaped cells squeezed between the columnar cells. They have a dark, lacy appearing material in them that may extend into the lumen. Know the function of goblet cells.

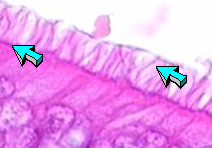
B. **PSEUDOSTRATIFIED EPITHELIA** a special form of simple epithelium.

**Pseudostratified Columnar Epithelium** - This is a modified simple columnar epithelium which is found in the trachea and bronchi. Its name comes from the LM observation that there are *multiple layers of nuclei* resembling stratified epithelia. However, at the EM level, it is clear that all cells make contact with the basal lamina. Some extend from basal lamina to lumen (columnar cells) while others do not reach the lumen (basal cells).

[**[MCO 0060]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0060&type=ax&section=epithelium) Trachea & Esophagus, Rodent [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0060&type=jv&section=epithelium) HIR-*frame 191-192*

[**[MCW 021]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW021&type=ax&section=epithelium) Trachea, H&E [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf3_MCW021&type=jv&section=epithelium)

[**[SL 035]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL035&type=ax&section=epithelium) Trachea [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf4_SL035&type=jv&section=epithelium)

(Psuedostratified Columnar Epitelium) (Basal Bodies and cilia)

As in the previous section, locate the trachea on **MCO 0060**. Study the pseudostratified columnar epithelium lining the tracheal lumen. Note the low, triangular cells directly adjacent to the basement membrane, the basal cells (the lowest stratum of nuclei in the epithelium). The columnar cells extend from the basement membrane to the lumen, their nuclei are oval and make up the outer stratum of nuclei. Notice that some of these cells are goblet cells similar to those observed in the colon, and others sprout cilia. Look at the other slides for similar diagnostic features.

C. **STRATIFIED EPITHELIA**

In stratified epithelia, *classification is based on cell shape of the surface layer of cells* and not the other layers, which may be a different shape than the surface layer.

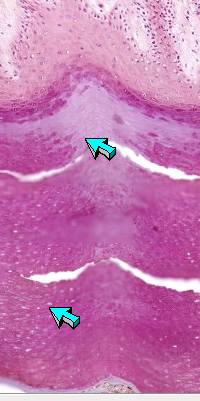
1) **Stratified Squamous epithelium** covers the entire outer surface of the body and orifices opening into it. Only the superficial layers are squamous and this tissue can be keratinized (skin) or non-keratinized (inside the oral cavity or vagina).

[**[MCO 0050]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0050&type=ax&section=epithelium) Skin, Cornified Human [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0050&type=jv&section=epithelium) HIR-*frames 178-180*

[**[LH 0078]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0078&type=ax&section=epithelium) Thick Skin [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0078&type=jv&section=epithelium)



(Stratified Squamous keratinized epethilium and Corneum)

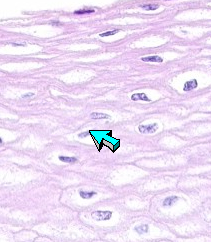
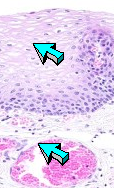
  

(Lucidum) (Granulosum – Bottom, Spinosum – Top) (Corneum –Bottom, Basale – Top)

In the **stratified squamous keratinized epithelium** of cornified skin (**MCO 0050**), the epidermis consists of 5 clearly defined layers on the bottom side of the section. These are listed from the free surface of the skin to the deepest of basal layer: corneum, lucidum, granulosum, spinosum, and basale (or germinativum). These layers will be studied much more intensively in the Integument Laboratory. For the purposes of this exercise, note the very thick stratum corneum (outermost layer), that is characteristic of thick skin. It is a layer of superficial flattened cells. This is the layer of empty or clear cells characteristic of keratinization. *No nuclei are present*. This layer is variable in thickness from 2 to 20 cells. On **LH 0078** slide the epithelium (epidermal component of skin) is on the right side of the section.

2) **Mucosal Stratified Squamous (Non-Keratinized) Epithelium** This type of epithelium lines areas of the digestive and reproductive tracts and often merges with the keratinized type of epithelium near the outside of the body (lip, pharynx, esophagus, vaginal orifice, anus).

[**[LH 0120]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0120&type=ax&section=epithelium) Esophagus, Middle [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf1_LH0120&type=jv&section=epithelium) HIR-*frame 175*

(Non-keratinized Stratified Squamous epithelium – LFT and Top RT, and Basale-

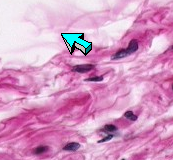
Bottom) 🡪 In between the two layers is the Stratum Spinosum

On this slide, note the major differences between mucosal and the above keratinized forms of stratified squamous epithelia. In mucosal epithelium, on the top side of the slide, only the stratum basale (germinativum) and stratum spinosum are present. The flat, clear cells at the surface of mucosal epithelium *still have nuclei.*

D. **TRANSITIONAL EPITHELIUM** (Uro-epithelium)

This type of epithelium is found only in the organs of the urinary system. This epithelium is specially constructed to allow distension under pressure, and contraction. These are conditions to which these organs are normally subjected. Electron microscopic studies have demonstrated that all cells are attached to the basement membrane via extensions of the plasmalemma. Therefore, this is really a specialized form of Pseudostratified Epithelium.

[**[MCO 0090]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0090&type=ax&section=epithelium) Urinary bladder, Non-Distended [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0090&type=jv&section=epithelium) HIR- *frame 197*

(Nondistended Transitional Epithelium – RT AND Alveolar Conective Tissue – LFT)

Observe the luminal surface (bottom surface covered with epithelium) of the organ and note that the transitional epithelium is comprised of three to seven layers of cells with the outer-most layer being cuboidal in shape.

**[**[**MCO 0091]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0091&type=ax&section=epithelium) Urinary Bladder, Distended [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0091&type=jv&section=epithelium) HIR-*frame 198*



(Distended Epithelium)

Note that the epithelium (bottom of tissue) of the distended bladder now appears to be only two to three cells thick, and that the surface cells appear almost squamous in some areas. Thus, as the bladder is distended, the surface cells change shape to allow expansion of the organ. In other words, the epithelium is in transition depending upon the degree of bladder distention.

**TYPES OF GLANDS**

In general, epithelial glands are either *unicellular* (e.g. goblet cells) or *multicellular*:

**Endocrine glands**, which *do not have a duct*, but secrete their product directly into the surrounding interstitial fluid and ultimately into the blood; or

**Exocrine glands**, which secrete their product *into a duct or from an "exposed" free surface*.

Multicellular exocrine glands are classified three ways:

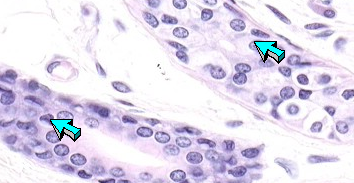
1) According to the **morphology or structure** of the gland. This is based on both;

A) *the branching structure of the duct portion of the gland*, and

B) *the shape of the secretory glandular portion*.

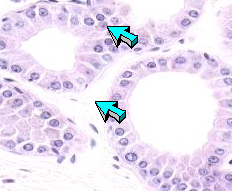
***A. Shape of the secretory portion***

[**[MCO 0052]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0052&type=ax&section=epithelium) Axillary Skin, Human [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0052&type=jv&section=epithelium) HIR-*frame 738*

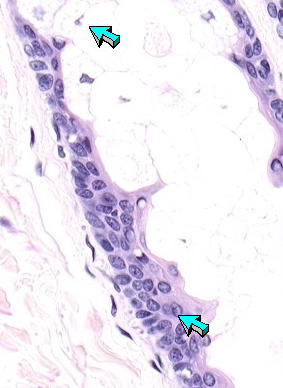
(Stratified Keratinized Squamous Epithelium) (Ducts = Stratified Cubodial and Secretory

region = Simple Cuboidal, Mesocrine)



(Ducts = Stratified Cubodial and Secretory

region = Simple Cuboidal, Apocrine)



(Sebaceous Gland aka Acinar gland)

[**[MCO 0652]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0652&type=ax&section=epithelium) Axillary Skin, Human [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0652&type=jv&section=epithelium)

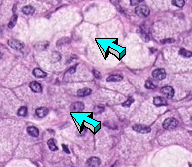
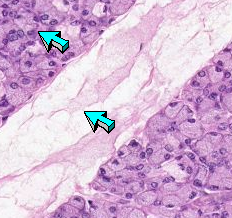


(Compound Acinar Gland)

1) Tubular glands - The *secretory region* can be straight, coiled, or branched tubes. Both types of sweat glands (merocrine sweat glands (small lumen and dark appearing) and apocrine sweat glands(large lumen and light appearing) have their secretory portion in the connective tissue region of this slide. Since these tubular glands are highly coiled, they appear as numerous, various shaped openings because of plane of section of the single coil.

2) Acinar glands - The gland region is "grape-like" or "flask-like," meaning that they occur as bunches of small sacs. The sebaceous gland, a simple gland associated with hair follicles, is an example of this gland shape.

[**[MCO 0081]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0081&type=ax&section=epithelium)Submandibular (maxillary) Gland [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0081&type=jv&section=epithelium) HIR-*frame 211*



(Stroma and Parenchyma) (Mucus Secreting = light, Sebum secreting = dark)

3) Tubuloacinar - The secretory units found in the submandibular salivary glands are a combination of tubes and acini. Recognize that it is difficult to differentiate between tubules and acini without doing serial section reconstruction. (Ie. All salivary glands are compound tubuloalveolar) We will return to this slide at the end of this laboratory for a closer examination, based on the type of secretory product. Just get the "Big Picture" now.

**B. *Structure of the duct***.

1) Simple - the ducts do **not** branch. The sweat and sebaceous glands seen on **MCO 0052** are examples of simple glands.

2) Compound - the ducts branch. The glands seen in **MCO 0081** are compound glands.

3) Note that the duct portion of the sweat glands are lined by stratified cuboidal cells (and appear darker), while the secretory portion of the gland is lined by simple cuboidal cells and appear lighter than the ducts.

2) According to **method or mode of secretion**.

[**[MCO 0052]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0052&type=ax&section=epithelium) Axillary Skin, Human [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0052&type=jv&section=epithelium) HIR-*frame 738*

[**[MCO 0652]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0652&type=ax&section=epithelium) Axillary Skin, Human [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0652&type=jv&section=epithelium)

You have already identified the merocrine and apocrine sweat glands, and the sebaceous glands near the hair follicles. Now you will classify them according to their mode of secretion.

a) **Merocrine glands** - These cells secrete their product by exocytosis without losing cytoplasm. Most glands are in this category. The small, darker stained sweat glands on this slide are this type.

b) **Apocrine glands** - These gland cells may release stored material with a very small amount of cytoplasm and plasmalemma surrounding the globule. The larger, apocrine sweat glands in this slide were once thought to be of this type (hence the name). However, with the advent of electron microscopy, it was proved that *these sweat glands actually used merocrine mode of secretion*. A clear example of this mode of secretion is seen in the active mammary glands.

c) **Holocrine glands** - These glands secrete their whole cell in a degraded form as the secretory product. The sebaceous glands are good examples of this mode of secretion. Note that one can see living cells, complete with nuclei and cell membranes at the base of the acini. These features disappear as the cells move towards the duct, die and degenerate.

d) **Cytocrine glands** � Are glands that also secrete the whole cell but in the living condition. Examples of these would be the ovary and testis and will be studied in Block II. .

3) According to **type of secretory product**.

[**[MCO 0081]**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0081&type=ax&section=epithelium) Submandibular (maxillary) Gland [**Java**](https://www.utdl.edu/WebSlides/launch.php?name=_BLIvf2_MCO0081&type=jv&section=epithelium)

HIR-*frames 211-213, 740*

This gland is a compound tubuloacinar gland, where the secretory region may have two types of secretion. These differences are explained below.

a) **Serous** glands - The secretory product from these glands is watery in nature. Since the cells are very active in protein synthesis, the cells are darker staining (basophilic) due to abundant rough E.R. and the quick release of their secretory product.

b) **Mucous** glands - secretes a mucous, viscous product. Since this product accumulates in the cytoplasm and is then washed out during the preparation of the slide, these cells are lighter stained and appear "washed-out," and have flattened, basal nuclei.

c) **Sebum** glands - The secretory product of these glands is oily in nature. The sebaceous glands **(MCO 0052)** are the classic examples of this type. They have a lacy appearance to their cytoplasm due to extraction of the lipid product. As the cells migrate from the periphery where they are produced to the duct they begin to die. Their nuclei become pyknotic and the cell membranes degenerate.

d) **Ceruminous** glands � they secrete wax and are found in the external auditory canal. We do not have any examples of these modified apocrine glands.